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Based on time series and RBF network plant disease forecasting

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Abstract

The RBF network is one novel effective forward neural network, it realizes through the nonlinear primary function's linear combination from space RN to the space RM nonlinear transformation, BFm and GM (1,1) combined model,especially qualify in nonlinear time series plant disease forecast. Model GM(1,1) was built for plant disease collected during simulative occurrence experiments. At the same time, the data of disease index and disease incidence were analyzed as reference.The results of experiments reveal that the co-deviation of Model GM(1,1) parameter a and b, cov(a,b), coincides with the standard deviation of disease index and disease incidence. This indicates that Grey system theory is effective for disease incidence analysis and the parameters of GM(1,1) can well reflect the change of plant disease occurrence.This article takes the forecast object by the wheat banded sclerotial blight, proposed that based on the RBF network's plant disease forecasting model, the simulation experiment showed that this model to the plant disease short and medium term forecast is possible effective.

Keywords: RBF; Plant disease; Time series; Forecast;GM(1,1)

1. Introduction

An artificial neural network (ANN) performs extraordinarily complex calculations im- itating biological in the real world without about course to exact quantitative. Back-propagation neural network (BPNN) is the most impor- tant and widely used one. Causes the network to study sampled data rule, uses to train the good network again to carry on the time series to the predict that therefore, stands the widespread application in nonlinear forecast[1].But forecasts the at the plant disease, the application

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neural network and the time series synthesis application example little reported. Tan spot and Stagonospora blotch of hard red spring wheat served as a model for evaluating disease forecasts by artificial neural networks[2].Plant disease cycles represent pathogen biology as a series of interconnected stages of development including dormancy, reproduction, spread, and pathogenesis. The progression through these stages is determined by a continual sequence of among host, pathogen, and environment. The stages of the disease cycle form the basis of many plant disease prediction models.

with the same font size as the rest of the paper. The paragraphs continue from here and are only separated by headings, subheadings, images and formulas. The section headings are arranged by numbers, bold and 10 pt. Here follows further instructions for authors. The of temperature and moisture to disease development and pathogen reproduction serve as the basis for most modern plant disease prediction[3]. Regression and artificial neural network (ANN) modeling approaches were combined to develop models to predict the severity of gray leaf spot of maize, caused by *Cercospora zeae-maydis*[4].

1.1. Palnt disease RBF network model

The RBF network is one three forward neural networks, it proposed by J.Moody and CDarken in 1989. Looked from the network architecture that it is by the first level, the second tacit strata and the third level composes. Since to occur plant diseases are many, which makes conventional modeling such as multiple regression difficult. Artificial neural networks (ANN) (4) provide an alternative or compliment to conventional approaches for model development. According to Francl (12), ANNs are extracting subtle patterns and deciphering complex among even when the being modeled is poorly understood. With ANN, the mathematical describing the being modeled do not have to be known because the network! In plant pathology, ANNs have been shown to perform just as well as or better than traditional multivariate approaches at classifying incidence and detecting infection periods of tan spot of wheat and predicting wheat scab epidemics[5-6].

2. forecast simulation experiments

2.1. GM (1,1) model

The data may regard as time series to carry on processing, therefore here supposes has the time series X = $\{x_i \in R$, i= 1, 2,…L,} the present hoped that through the sequence previous N day value, forecasts the latter M day value (Table1.).

Table.1 GM (1,1) model forecasts data

X1	X2	X3	X4	X5	X6	X7	X8	X9	X 10
15.1	21.13	22.17	25.18	28.13	29.15	31.18	32.19	38.17	45.12

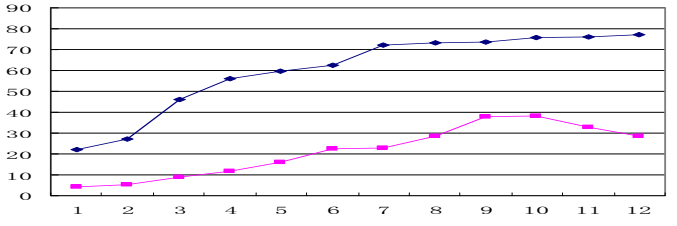

Figure.1 GM (1,1) model Forecasting result diagram of curves

GM (1,1) model :parameter: a=-0.091687, b=18.036254 ,x(t+1)=211.816169e0.091687t+-196.716,results figture.1， The black line represents the disease rate， Red line shows the disease index.To current model appraisal: C=0.1870 is very good, p=1.0000 is good.

2.2. network trainings and forecast

In trains in the, to prevent to has studied the data fitting is good, but to has not studied data fitting not good [5]. Uses the trundle type study method, soon the continual10 -long data net's vector, the 10 times plant disease data price matches as the constitution rightly.

Table.2 concealment level each point weight

3.2696	-1.0818	-0.3532	1.2057	-6.7279	1.2103	0.0588
1.9764	-0.1598	0.1990	-0.7172	1.9227	-0.0340	0.1551
-1.0719	-0.8592	-0.3600	-0.1535	0.1299	1.2009	0.7785
-0.6959	-0.9206	-1.3134	-0.0144	2.5236	-2.4553	-2.2609
-2.9741	0.3417	0.1960	0.2000	-5.6926	-3.3767	-2.5510
-2.1617	0.0028	0.0196	0.4941	-0.3898	1.4727	0.1317
2.1908	-0.8639	-0.4694	1.4526	-4.9785	-1.6861	-1.2867

When forecast may use many step forecasts and forecast on foot. Many step forecasts are after getting the value, the training sample does not make the matching change, continues the forecast next value, but forecasts opposite on foot namely. Because many step forecast's errors are big, this article uses forecast on foot that and forecast gets smallest mean square deviation MSE judges the model the fit and unfit quality. Here supposes the radial direction primary function's width is 1. 0, the goal error is 0.01, after the training completes, when the implicit strata nerve nerve number lasts, the goal error is satisfies the study the untrue question. The forecasting result curve and the curve, as shown in Figure.2 and table 3, the fitting is good, basic can reflect plant disease's event tendency., Predictive value of the red lines, blue lines represent the value. Training precision. Training accuracy 0.009260.The variable (final sickness refers) trains the table.

Table.3 The variable (final sickness refers) trains the result

Record number	Predicted value	value	error	Relative error
1	0.617056	0.6	0.017056	0.028426
2	0.105496	0.1	0.005496	0.05496
3	0.259954	0.37	0.110046	0.297422
4	0.1548	0.08	0.0748	0.934998
5	0.23492	0.02	0.21492	10.746015
6	0.685695	0.75	0.064305	0.08574
7	0.369756	0.65	0.280244	0.431144
8	0.405878	0.36	0.045878	0.127438
9	0.583551	0.62	0.036449	0.058788
10	0.288754	0.33	0.041246	0.124987
11	0.366582	0.3	0.066582	0.221939
12	0.219009	0.06	0.159009	2.650152
13	0.291016	0.34	0.048984	0.144069
14	0.164969	0.17	0.005031	0.029592
15	0.098265	0.14	0.041735	0.298109
16	0.663488	0.58	0.083488	0.143945
17	0.163432	0.15	0.013432	0.089548
18	0.297921	0.27	0.027921	0.103411
19	0.104664	0.08	0.024664	0.308294
20	0.145736	0.2	0.054264	0.271322

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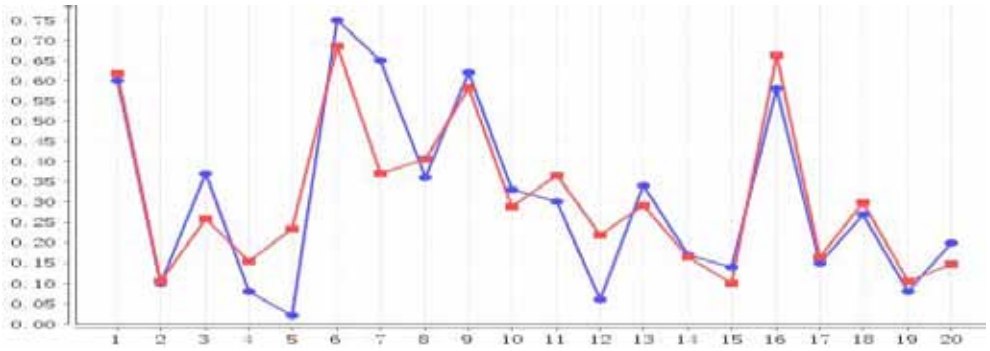

Figure.2 Forecasting result diagram of curves

3. conclusion

GM(1,1) and artificial neural network (ANN) modeling approaches were combined to develop models to predict the occurrence wheat sharp eyespot.But because plant disease's happening is a complex nonlinear, plant disease's happening many kinds of influences, this article is considered only plant disease's happening constitution time seriesa, setup GM(1,1) and RBF neural network model. Thus has certain error, to be how related the influencing (weather, germ, environment and so on) considers also to together the further discussion.The radial direction base (Radial Basis, is called RBF) network is one novel effective forward neural network, simultaneously enabled the network to have the strong nonlinear mapping ability.

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References

[1].Wargon, M., E. Casalino and B. Guidet, From model to forecasting: a multicenter study in emergency departments. Acad Emerg Med, 2010. 17(9): p. 970-8.

[2].De Wolf, E.D. and L.J. Francl, Neural network classification of tan spot and stagonospora blotch infection periods in a wheat field environment. Phytopathology, 2000. 90(2): p. 108-13.

[3].De Wolf, E.D. and S.A. Isard, Disease cycle approach to plant disease prediction. Annu Rev Phytopathol, 2007. 45: p. 203-20.

[4].Paul, P.A. and G.P. Munkvold, Regression and artificial neural network modeling for the prediction of gray leaf spot of maize. Phytopathology, 2005. 95(4): p. 388-96.

[5].Paul, P.A. and G.P. Munkvold, Regression and artificial neural network modeling for the prediction of gray leaf spot of maize. Phytopathology, 2005. 95(4): p. 388-96.

[6] Zaqoot, H.A., et al., Prediction of dissolved oxygen in the Mediterranean Sea along Gaza, Palestine - an artificial neural network approach. Water Sci Technol, 2009. 60(12): p. 3051-9.